IN THE MATTER OF

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By Samsung Electronics Co., Ltd.

I, So-hee Kim, an employee of Y.P.LEE, MOCK & PARTNERS of The Cheonghwa Bldg., 1571-18 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare that I am familiar with the Korean and English languages and that I am the translator of the priority document (Korean Patent Application No. 99-31057) and certify that the following is to the best of my knowledge and belief a true and correct translation.

Signed this 24th day of February 2004.

Sohee Kim

A B S T R A C T

[Abstract of the Disclosure]

A connection management method between devices which are connected by a digital interface and the command structure therefor are provided. The connection management method, in a network system where a device for transmitting data using a predetermined data transmission format and a device for receiving data are connected by a predetermined digital interface, includes the step of informing another device of various connection status changes for data transmission flow in the course of transmitting real time data between devices connected by a predetermined digital interface format, as well as the step of informing another device of a connection status change which may occur in any of devices whose connection is established. Accordingly, the other device is able to cope with the possible changes, which allows more efficient management for connection status.

[Representative Drawing]

FIG. 5

SPECIFICATION

[Title of the Invention]

Connection Management Method for Devices Connected by Digital Interface and Command Structure therefor

[Brief Description of the Drawings]

FIG. 1 is a schematic diagram of a network system connected via a general IEEE 1394 bus;

FIG. 2 is a diagram of the format of the output plug control register (oPCR) shown in FIG. 1;

FIG. 3 is a diagram of the format of the input plug control register (iPCR) shown in FIG. 1;

FIG. 4 is a diagram of a connection management command structure according to the present invention; and

FIG. 5 is a flowchart of a connection management method according to an embodiment of the present invention.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Prior Art Belonging to the Invention]

The present invention relates to the field of data transmission control, and more particularly, to a connection management method in which the user is informed of a change in connection management status between devices connected by a digital interface, and a command structure therefor.

Household or industrial equipments can be interconnected by a bus of a predetermined digital interface format such as the Institute of Electrical and Electronics Engineers, Inc., (IEEE) 1394 to transmit or receive real-time data to or from each other. For example, when a digital television (DTV), digital video camcorder, a set-top box (STB), and the like are interconnected via the IEEE 1394 to form a network, real time data such as video and audio information is transmitted between these devices.

In FIG. 1, which is a schematic view showing a general network system connected via the IEEE 1394, real time data is output from a virtual output plug of one device and input to an input plug of another. In this case, the connection is made conceptually, not physically. A source device (herein STB 100), which has an output plug 101, for transmitting information includes an output plug control register (oPCR) 111 for controlling the flow of information output through the output plug whereas a sink device (herein DTV 200), which has an input plug 201, for receiving information includes an input plug control register (iPCR) 211 for controlling the flow of information input to the input plug 201. A control device having a controller 300 can be one of the STB 100 and the DTV 200, or another third-party device, and the control device serves to establish a connection so that the control value of the oPCR 111 and the iPCR 211 can be controlled to transmit data, or break the connection.

Thus, real time data is transmitted from the output plug 101 to the input plug 201. In this case, the related control information is written in the oPCR 111 and the iPCR 211 corresponding to each plug, and the controller reads a value written in the oPCR 111 and the iPCR 211 or writes a control value therein to control the flow of real time data.

The control value to be written in the oPCR 111 and the iPCR 211 will now be described in conjunction with FIGs. 2 and 3. The format of the 32-bit oPCR 111 shown in FIG. 2 is described as follows. The numbers denote the number of allotted bit(s). On-line indicates whether a corresponding output plug is on-line ("1" value) or off-line ("0" value). A broadcast connection counter denotes whether a broadcast-out connection exists ("1" value) or not ("0" value) in the output plug, whereas a point-to-point connection counter indicates the number of point-to-point (p2p) connections existing in the output plug. Channel number indicates a channel number which can be used for the output plug to transmit an isochronous data flow when the output plug is activated. Data rate represents transmission speed (or bit rate) required for the output plug to transmit the isochronous packet of an isochronous data flow when the output plug is activated. An overhead ID represents the bandwidth required in addition to a bandwidth required for transmitting the payload of an isochronous packet. The payload means the maximum size of isochronous data to be output from the output plug when the output plug is

activated.

The format of the 32-bit iPCR 211 shown in FIG. 3 is as follows. The numbers denote the number of allocated bit(s). On-line indicates whether the relevant input plug is on-line ("1" value) or off-line ("0" value). A broadcast connection counter denotes whether a broadcast-in connection exists ("1" value) or not ("0" value) in the input plug, whereas a point-to-point connection counter indicates the number of p2p connections existing in the input plug. Channel number indicates a channel number which can be used for the input plug to receive an isochronous data flow.

Thus, if a control device having a controller is allocated a channel value to be used to write each channel value allocated in oPCR 111 and iPCR 211 in channel number shown in FIGs. 2 and 3 and to write other control values (i.e., on-line bit value, connection counter value, etc.) in the oPCR 111 and the iPCR 211, the relevant source and sink devices transmit or stop transmission of the information depending on those values.

As shown in FIGs. 2 and 3, there are two kinds of connections for transmitting information: the p2p connection and the broadcast connection. In the case of the p2p connection, only a control device by which a connection is established can break the connection. Thus, in the case where a third-party control device establishes a p2p connection, source and sink devices, between which the connection is established, must each transmit and receive information even if the devices do not desire to do so.

To overcome the above problem, when either device does not desire to receive or transmit data any longer, an algorithm for informing a control device or the connected other device of this fact has been presented by defining a new control command in an audio-video/control command transaction set (AV/C CTS). Specifically, when any change occurs in a device for transmitting or receiving real time data, a new control command is defined in AV/C CTS to indicate this change. According to the AV/C CTS, information as to whether each input plug desires to receive any input or not, and whether each output plug desires to output or not, is available. Further, this is the case if a signal output from an output plug is transformed. However, when using a command of the AV/C CTS, there is a

problem in that changes in other factors for controlling data flow, such as the bandwidth and information as to how many devices are connected to a connection in question, are not available.

[Technical Goal of the Invention]

To solve the above problem, it is an object of the present invention to provide a connection management method of indicating various connection status changes related to data transmission flow, such as the status of data transmission and reception, data process capability, and the bandwidth of data, during the transmission of real time data between devices connected by a predetermined digital interface format.

It is another object of the present invention to provide a connection management method for generating a connection management command to transmit various connection status changes for data transmission flow in response thereto.

It is still another object of the present invention to provide a connection management command structure for indicating various connection status changes in data transmission flow in the course of transmitting real time information between devices connected by a predetermined digital interface format.

Accordingly, to achieve the above object, the present invention provides a method of managing a connection between devices in a network system in which one or more devices for transmitting data using a predetermined data transmission format and one or more devices for receiving data are connected by a predetermined digital interface. The connection management method according to the present invention includes the step of informing another device of a connection status change which occurs in any of the devices in which the connection is established.

To achieve another object of the present invention, a connection management method according to the present invention includes the steps of establishing a connection between a device for transmitting information through a predetermined data transmission format and a device for receiving information, both of which are connected by a predetermined digital interface, sending a connection

management command for controlling connection management status, and controlling the connection when a response to the connection management status change is received according to the connection management command.

To achieve still another object of the present invention, a connection management command structure, for indicating various connection status changes between devices whose connection is made in a network system where a device for transmitting data using a predetermined data transmission format and a device for receiving data is connected by a digital interface, includes connection register type information which represents an output plug control register within the device for transmitting information or an input plug control register within the device for receiving information, and identification information on an input/output plug at which connection is established.

[Structure and Operation of the Invention]

Hereinafter, a connection management method for devices connected by digital interface and command structure therefor according to preferred embodiments of the present invention will be described in detail with reference to the attached drawings.

According to the present invention, when a change occurs in the control value of the output plug control register (oPCR) and the input plug control register (iPCR) defined in the format of IEC 61883 (Specification of Digital Interface for Electronic Audio/Video Equipment, Part 1, December 1995, HD Digital VCR Conference), which is a data transmission format in devices using the IEEE 1394 format, a connection management command structure for informing a control device or another device connected thereto of this change is defined as shown in FIG. 4, while conforming to a command form defined in the audio-video/control command transaction sets (AV/C CTS) is followed.

In FIG. 4, an operation code is defined connection management, and an operand [0] is assigned 1 byte. The 1-byte field includes the most significant bit (MSB) indicative of a connection register type (iPCR/oPCR), the following 1-bit which is reserved, and the remaining 6-bits indicative of plug identification information about a plug number at which a connection is established. Adding other operands

(operand [1]-operand [4]) to operand [0], allows transmission of various information about connection management.

Specifically, the transmission of an unnecessary response can be prevented by designating only some bit fields in the format of oPCR shown in FIG. 2 (on-line, broadcast connection counter, point-to-point connection, channel number, data rate, overhead ID, and payload) and by designating only some of bit fields in the format of the iPCR shown in FIG. 3 (on-line, broadcast connection counter, point-to-point connection, channel number). Thus, when a control device desires to know a change in some bit fields out of 32 bits of the oPCR or the IPCR, a control device has only to set the bit positions of corresponding bit fields to "1" using operands (operand[1]-operand [4]) to transmit the set operand to a source or sink device employing a notify command. For instance, if only on-line bit field is desired, only the desired bit can be designated. In other words, if a bit position corresponding to on-line is b0, transmission can be made in such a way as to set only a bit position corresponding to b0 in an operand (e.g., operand[1]) to "1" and to set the remaining bits to "0".

In addition to the factors included in the connection management format shown in FIGs. 2 and 3, e.g., operand [n] about whether the connection is only for a private purpose or not, can be added in the connection management structure shown in FIG. 4. Thus, one device (a control device) connected via the IEEE 1394 transmits to another device (source device or sink device) by designating an output plug or an input plug in the connection management command shown in FIG. 4. In this case, the connection management command can be defined as a new command of a notify command defined in AV/C CTS. There are several types of AV/C CTS commands among which a notify command is a command, wherein, if a controller transmits a notify command when it desires to know about the future change of a status, a device (also known as a target) in receipt of the notify command firstly responds by sending its own current status to a controller, and if the status is changed later, the target responds by sending the changed status to the controller once more.

In the present invention, if a connection management notify command shown in FIG. 4 is transmitted and a change occurs in any bit of a plug control register

designated by the connection management notify command, the device in receipt of the notify command retransmits this change to a device which transmits the notify command as a response. The device which receives this response reads information about a corresponding plug control register of the other device, checks which bit field is changed, and takes an appropriate measure according to which of the bit fields is changed.

Specifically, in the case in which a device that receives a notify command is a source device having an oPCR, if the on-line bit field among several kinds of bit fields is changed from "1" to "0", it can be interpreted that the source device does not transmit an output or does not desire to do so, so that a control device breaks its connection with the source device. Contrarily, if the on-line bit field is changed from "0" to "1" the source device desires to transmit the output, so that the control device establishes its connection with the source device. For example, if a DTV outputs no signal upon the termination of regular broadcasting programs, then the control device breaks its connection with DTV.

In the case where the value of broadcast connection counter or p2p connection counter is changed, it indicates a change in a connection status by overlaying other devices on the already established connection or breaking the overlaid connection. While the value of a p2p connection counter is "1" since a source device having a control device establishes the connection, if this value is changed to "2", it can be regarded that another device receives the information output from the source device. In this case, if a connection is established only for a private purpose, the user can be informed that the information accessed by him/her can also be accessed by other people, thereby allowing the user to appropriately cope with this situation.

If the value of a payload representing the bandwidth of output information among bit fields of the oPCR is changed, a control device can take an appropriate measure based on the changed output information bandwidth of a source device and the bandwidth that a sink device is able to input. For example, if the bandwidth of output information transmitted by the source device exceeds the bandwidth that a sink device is able to receive and handle, the control device can break a connection of the sink device, thereby preventing the sink device from receiving any further

information.

In the same manner, in the case in which a device that receives a notify command is a sink device having an iPCR, if the on-line bit field is changed from "0" to "1", it can be deemed that the sink device desires to receive an input, so that a control device establishes the connection of the sink device. In the opposite case, the sink device cannot be deemed to desire an input any more , so that the control device can break the connection of the sink device. For example, when a video cassette recorder (sink device) ends all recordable regions of the video tape and goes into a blank signal region, the user can be immediately informed of this to eject or replace the tape.

FIG. 5 is a flowchart of a connection management method according to an embodiment of the present invention, in which a connection management method is performed by a control device including a controller. Referring to FIG. 5, a connection is established between a source device and a sink device according to the procedure defined in IEC 61883 (step S101). In this case, a connection can be either a point-to-point connection or a broadcast connection. Then, a connection management notify command is sent to the source device and/or the sink device (step S102). While waiting (step S103) until a notify response to a connection management change arrives, after receiving a response to the current status from a device in receipt of the notify command, a notify response to a change in the bit field of the corresponding plug control register of the device in receipt of the notify command is received (step S104).

When a response is received at the step S104, firstly a change in the on-line bit field is checked (step S105). If the on-line bit field among bit fields of a corresponding plug control register is changed to "0", a connection is broken (step S106). On the other hand, if the on-line bit field still remains "1" in the step S105 and a private connection is established, then it is checked whether the value of a broadcast connection counter or a p2p counter is changed (step S107). If a change occurs, the user is informed that it is an overlay connection so that an appropriate measure can be taken (step S108). If there is no change in a connection counter value at the step S107, it is checked whether a payload among bit fields of a corresponding plug control register is changed (step S109), and if a payload is

changed, a bandwidth is adjusted (step S110). Then, it is checked whether the adjusted bandwidth can be accepted by the sink device for inputting data (step S112). In this case, if the adjusted bandwidth is too wide, the connection of the sink device is broken (step S112), while if not, the step S102 proceeds such that a connection management command is transmitted.

[Effect of the Invention]

According to the present invention, a connection is allowed to be broken when one among a plurality of devices connected by a digital interface does not desires to transmit output nor receive input any more. Therefore, there is no waste in the bandwidth due to the establishment unnecessary connections, and only the required bandwidth is used, which enhances the efficiency of bandwidth use.

Further, in the present invention, one device can be immediately informed of several kinds of status changes (e.g., status of data transmission and reception and data process capability) which may occur in the data processing by another device, thereby allowing the user to promptly understand the status changes which occur inside the connected devices, and to cope with these changes.

In addition, the present invention can indicate changes in the number of sink devices connected to the source device and in the bandwidth that the source device and the sink device are able to output and input, respectively, as well as information on whether a source device desires to transmit data or not. For example, if the number of sink devices connected to a source device is increased, the user is informed of this change, so that if another device does not desire to be connected thereto, the connection of another device is not allowed. Thus, this allows a more efficient connection status management.

What is claimed is:

1. A method of managing a connection between devices in a network system in which one or more devices for transmitting data using a predetermined data transmission format and one or more devices for receiving data are connected by a predetermined digital interface, the method comprising the step of:

(a) informing another device of a connection status change which occurs in any of the devices in which the connection is established.

2. The method of claim 1, wherein the other device is a device which transmits a connection management notify command.

3. The method of claim 2, wherein the other device is a control device or the other party device in which a connection is established.

4. The method of claim 1, wherein the predetermined digital interface is the IEEE 1394 format and the predetermined data transmission format is the IEC 61883 format.

5. The method of claim 1, wherein, in the step (a), if any of the bit fields of an output plug control register within the device for transmitting information and/or any of the bit fields of an input plug control register within the device for receiving the information are changed, the other device is informed of this change, and

wherein the output plug control register and input plug control register are a register for controlling a connection defined in the format of IEC 61883.

6. The method of claim 1, wherein, in the step (a), if a bit field representing on-line or off-line is changed in the device for transmitting data, the other device is informed of this change.

7. The method of claim 1, wherein, in the step (a), if a bit field representing on-line or off-line is changed in the device for receiving data, the other device is informed of this change.

8. The method of claim 1, wherein, in the step (a), if a change in the bandwidth of output information in the device for transmitting information is followed by a change in a payload bit field, the other device is informed of this.

9. The method of claim 1, wherein, in the step (a), if a connection counter bit field changes depending on a change in the number of devices for receiving information from the device for transmission, the other device is informed of this.

10. The method of claim 9,wherein the step (a) further comprises the step of stopping devices other than the original receiving device which desire to receive information from receiving information, if the number of devices for receiving information from the device for transmission is increased.

11. A connection management method comprising the steps of:

(a) establishing a connection between a device for transmitting information through a predetermined data transmission format and a device for receiving information, both of which are connected by a predetermined digital interface.

(b) sending a connection management command for controlling connection management status; and

(c) controlling the connection when a response to the connection management status change is received according to the connection management command.

12. The method of claim 11, wherein the predetermined digital interface is the IEEE-1394 format, and the predetermined data transmission format is the IEC 61883 format.

13. The method of claim 11, wherein, in the step (b), the connection management command complies with a notify command form of the format of audio-video/control command transaction sets.

14. The method of claim 11, wherein, in the step (c), if any of bit fields of an input plug control register and/or an output plug control register, both of which are a connection control register defined in the format of IEC 61883, is changed, a response to the connection management status change is received.

15. The method of claim 11, wherein, in the step (c), if the response indicates a change of a bit field representing on-line or off-line in the device for transmitting information a connection is broken or established.

16. The method of claim 11, wherein, in the step (c), if the response indicates a change in a bit field representing on-line or off-line in the device for receiving information a connection is broken or established.

17. The method of claim 11, wherein, in the step (c), if the response indicates a change in a payload bit field resulting from a change in the bandwidth of output information in the device for transmitting information, a connection is broken or established depending on whether the bandwidth of the output information can be accepted by the device for receiving information.

18. The method of claim 11, wherein, in the step (c), if the response indicates a change in a connection counter bit field due to a change in the number of the devices for receiving information in the device for transmitting information, a connection of a device which desires to receive information is broken or established.

19. The method of claim 18, wherein the step (c) further comprises the step of informing the user so as to stop devices other than the original receiving device from receiving information, if the number of the devices for receiving information from the device for transmitting information is changed and a private connection is established.

20. A command structure for indicating a connection status change between devices whose connection is established in a network system where a

device for transmitting data through a predetermined data transmission format and a device for receiving data are connected by a predetermined digital interface, the command structure comprising connection register type information which represents an output plug control register within the device for transmitting information or an input plug control register within the device for receiving information, and identification information on an input/output plug at which connection is established.

21. The command structure of claim 20, wherein the connection management command complies with the form in the format of audio-video/control command transaction sets.

22. The command structure of claim 20, wherein the predetermined digital interface is the IEEE 1394 format, and the predetermined data transmission format is the IEC-61883 format.

23. The command structure of claim 20, wherein an operand for designating some of bit fields of the output plug control register and/or the input plug control register is added.

24. The command structure of claim 20, wherein an operand representing whether the connection is for a private purpose or not is added.

FIG. 1

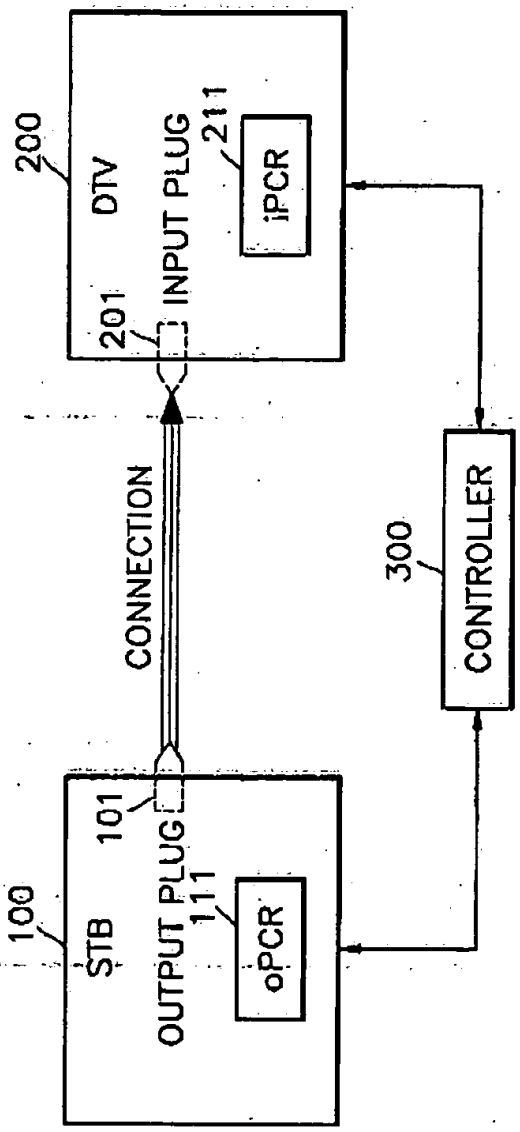

FIG. 2

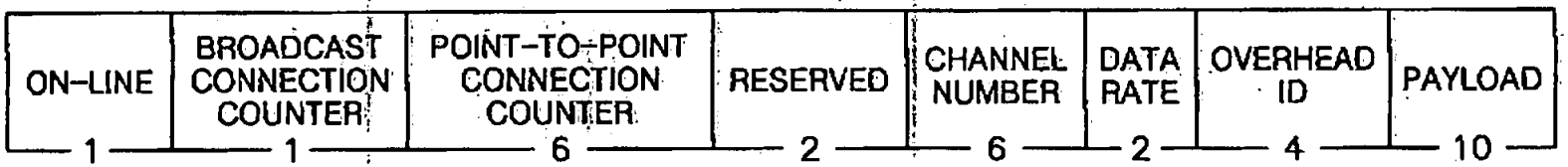

FIG. 3

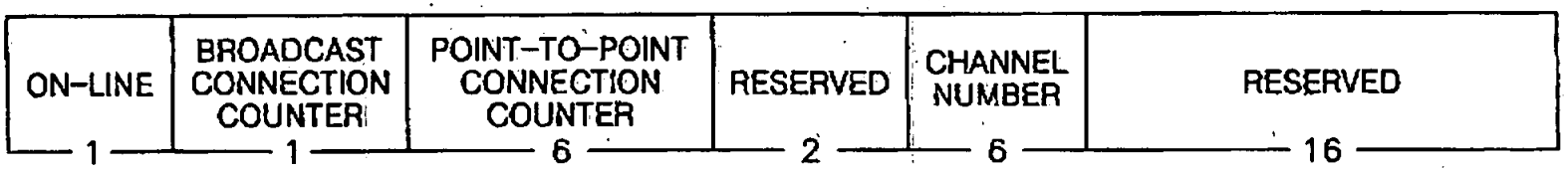

FIG. 4

	MSB					LSB
OPCODE	CONNECTION MANAGEMENT (XX_{16})					
OPERAND [0]	I/O	RESERVED	PLUG NUMBER (6BITS)			
OPERAND [1]	PCR LOCATION (MSB)					
⋮	⋮					
OPERAND [4]	PCR LOCATION (LSB)					

FIG. 5